1,131,479

PATENT SPECIFICATION

DRAWINGS ATTACHED

1,131,479

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Int. Cl.:—B 60 g 9/04

COMPLETE SPECIFICATION

Motor Vehicle Suspension Systems

We, VAUXHALL MOTORS LIMITED, a British Company, of Kimpton Road, Luton, Bedfordshire, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement: —

This invention relates to motor vehicle suspension systems, and to suspension assemblies for use in such systems.

The suspension systems with which the present invention is concerned include a De Dion tube, that is, an axle member (dead axle) which extends transversely of the vehicle to interconnect wheel carriers of a transverse pair of driven wheels for maintaining the wheels at a constant camber angle as they move up and down at the outer ends of respective drive shafts whose inner ends are pivotally connected to a differential gear assembly forming part of a sprung portion of the vehicle.

According to the present invention, a suspension assembly for use in a motor vehicle suspension system comprises a De Dion tube made up of two parts having overlapping end portions which extend coaxially one into the other, an annular anti-friction bearing which is fitted between the overlapping end portions of the tube and is constructed and arranged to resist relative telescopic movement of the two parts of the tube, and an annular resilient bushing which is fitted between the overlapping end portions of the tube at a position axially spaced from the anti-friction bearing and is constructed and arranged to resiliently resist relative torsional movement of the two parts of the tube.

According to the present invention, also, a motor vehicle suspension system comprises: an axle assembly including a transverse pair of wheel carriers interconnected by a suspension assembly as aforesaid, disposed with the De Dion tube extending transversely of the vehicle; a differential gear assembly which forms part of a sprung portion of a vehicle and includes opposed output shafts that are pivotally connected by way of respective pivotal drive shafts for driving respective wheels rotatably mounted on respective wheel carriers; a first pair of pivotal links arranged with front end portions thereof pivotally connected to a frame or body portion of the vehicle, and with rear end portions thereof pivotally connected to the axle assembly at positions lower than the axis of rotation of the wheels; and a second pair of pivotal links arranged with rear end portions thereof pivotally connected to the frame or body portion of the vehicle, and with front end portions thereof pivotally connected to the axle assembly at positions higher than the axis of rotation of the wheels.

Main suspension springs of the suspension system, for example helical compression springs, may act on the first pair of pivotal links.

The anti-friction bearing of the suspension assembly is conveniently a ball bearing having an inner race fitted on the inner of the coaxially overlapping end portions of the tube, and an outer race in engagement with the inner surface of the outer of the end portions of the tube.

The annular elastomeric bushing of the suspension assembly may be made of either natural rubber, a modified natural rubber, or a synthetic elastomer. This bushing may be fitted on the inner of the coaxially overlapping end portions of the tube, and fit tightly against the inner surface of the outer of the coaxially overlapping end portions of the tube.

Preferably the anti-friction bearing is disposed in the region of the free end of the outer of the coaxially overlapping end portions of the tube, whereas the annular elastomeric bushing is disposed in the region of the free end of the inner of the coaxially overlapping end portions of the tube.

An annular sealing boot of elastomeric mat-

erial can interconnect the two parts of the De Dion tube, to prevent the entry of dirt and moisture.

The differential gear assembly may be mounted directly on a frame or body portion forming the main sprung portion of the vehicle. Preferably, however, the differential gear assembly forms part of a sub-frame that is resiliently connected to the main spring portion of the vehicle. Such a sub-frame may be substantially H-shaped as seen in plan, with the arms of the H extending either transversely of the vehicle or obliquely.

Transverse location of the De Dion tube is conveniently by means of a transversely extending pivotal link (Panhard road) having one end pivotally connected to an end portion of the De Dion tube, or to one of the wheel carriers, and its other end pivotally connected to the frame or body portion of the vehicle.

Because the annular anti-friction bearing resists relative telescopic movement of the two parts of the De Dion tube, the wheel carriers remain a substantially constant distance apart as the wheels move up and down. In other words, the wheel track remains constant. However, geometrical considerations require that the effective length of the pivotal drive shafts shall vary as the wheels move up and down: such variation can be obtained by including a splined or other telescopic coupling in each of the drive shafts, but is more conveniently obtained by incorporating a resilient pivotal coupling joint at one end at least, preferably the inboard end, of each of the pivotal drive shafts.

The suspension system as aforesaid is primarily intended for the driven rear wheels of a front-engined motor vehicle, and the invention also includes a front-engined motor vehicle having a suspension system as aforesaid for a pair of driven rear wheels of the vehicle.

The appended claims define the scope of the invention claimed. The invention and how it can be performed are hereinafter particularly described with reference to the accompanying drawings, in which:—

Fig. 1 is a fragmentary perspective of one embodiment of a suspension assembly according to the invention, arranged in place as part of a rear suspension system for the driven rear wheels of a front-engined motor vehicle;

Fig. 2 is a front view of the suspension assembly portion of the system shown in Fig. 1;

Fig. 3 is a view similar to Fig. 2, but with the parts of a De Dion tube in the suspension assembly separated to show an annular bushing and an annular bearing which fit between the parts; and

Fig. 4 is an enlarged view, partly in section, showing details of the annular bushing and bearing.

In the embodiment of the motor vehicle suspension system according to the present invention, which is shown in Fig. 1, and specifically is a suspension system for the driven rear wheels of a front-engined motor vehicle, a sprung portion of the vehicle includes a pair of longitudinally extending frame members 10 and 12 formed near their rear ends with respective upwardly offset portions to accommodate parts of the suspension system. These upwardly offset portions of the longitudinal members are interconnected by means of a frame cross member 14.

In the region of the upwardly offset portions, there is an axle assembly including a transverse pair of wheel carriers 16 for respective rear wheels 18 of the vehicle. The wheel carriers are interconnected by a two-part De Dion tube 20, the junction between the two parts of the tube being protected by means of an annular sealing boot 22 which is made of elastomeric material and fits tightly round the two parts 24 and 26 of the tube to prevent the escape of lubricant and prevent the entry of dirt and moisture. The De Dion tube 20 is a dead axle, that, is although it connects the wheel carriers together, it does not contain any drive shaft for the vehicle wheels. A brake backing plate 27 for a drum brake or disc brake is fixed to each of the wheel carriers.

The De Dion tube axle assembly is pivotally connected to the vehicle frame by means of a pair of trailing arms, comprising a first pair of pivotal links 28 and 30 arranged with front end portions thereof pivotally connected to the longitudinal frame members of the vehicle, and with rear end portions thereof pivotally connected to the brackets 32 and 34 fixed to the axle assembly. The rear pivotal connections for the trailing arms, namely the pivotal connections between these links and the axle assembly, are disposed at positions lower than the axis of rotation of the wheels, vertically below the axis of wheel rotation. A pair of helical compression springs 36 and 38, forming the main suspension springs for the rear axle assembly, act on the respective pivotal links near the rear pivots thereof.

There is also a second pair of pivotal links 40 and 42, arranged with rear end portions thereof pivotally connected to the longitudinal frame members rearwardly of the upwardly offset portions, and with front end portions of the pivotal links pivotally connected to the axle assembly at positions higher than the axis of rotation of the wheels, vertically above the axis of wheel rotation. The first and second pairs of pivotal links together form a "Watts" linkage, for controlling the attitude of the axle assembly and absorbing braking reaction forces and vehicle drive forces. A pair of telescopic dampers 44 and 46 act on the axle assembly in the region of the brackets.

The suspension system also includes a differential gear assembly 46. In this assembly, a housing portion 50 of a conventional differential gear is bolted to a pair of rear arms

52 and 54 which extend transversely of the vehicle, and to a pair of front arms 56 and 58 which extend obliquely forwardly from the differential housing 50. The differential gear housing portion and the two pairs of arms thereby form a sub-frame which is H-shaped as seen in plan; the outer ends of the arms are resiliently connected to the longitudinal frame members by means of annular elastomeric bushings such as 60.

A conventional propeller shaft 62 driven by the vehicle engine is connected by way of a universal joint 64 to an input pinion shaft 66 of the differential gear assembly. A pair of opposed output shafts 68 of the differential gear assembly are pivotally connected by means of resilient pivotal coupling joints 70 to the inboard ends of a respective pair of pivotal drive shafts 72 and 74 the outer ends of which are connected by means of universal joints 76 to drive the rear wheels. Each of the coupling joints 70 basically comprises a ring of elastomeric material connected by a first set of three bolts to a spider portion formed on the respective output shaft 68 of the differential gear assembly, and connected by a second set of three bolts to a spider portion formed on the respective pivotal drive shaft 72 or 74, the two sets of bolts being in staggered relationship.

The input pinion shaft 66 of the differential gear assembly extends through a central aperture in a channel-section sheet metal portion 78 which interconnects the two obliquely extending arms of the sub-frame, the sides of the channel-section portion being bolted to the front portion of the differential housing with the interposition of distance pieces.

The two-part De Dion tube 20, in conjunction with the brackets 32 and 34 providing a connection for the trailing arms 28 and 30, and also in conjunction with the wheel carriers 16 and the pivotal drive shafts 72 and 74, forms a suspension assembly. This suspension assembly is located in a direction transversely of the vehicle by means of a transversely extending pivotal link, namely a Panhard rod 80, one end of which is pivotally connected to the left-hand end portion of the axle assembly and the other end of which is pivotally connected to the right-hand longitudinal frame member.

As is best seen in Figs. 2 and 4, the two parts 24 and 26 of the De Dion tube 20 overlap, with their adjacent end portions 82 and 84 extending coaxially one into the other. An annular anti-friction bearing, namely an ordinary ball bearing 86, fits between the coaxially overlapping tube portions, in the region of the free end of the outer tube portion 84. The radially inner race of the ball bearing 86 is fitted on the inner tube end portion 82, and the outer race of the ball bearing is in engagement with the inner surface of the outer tube end portion 84. The ball bearing 86 takes up substantially all radial and axial play between the inner and outer tube portions.

An annular elastomeric bushing 88, made of natural rubber, is fitted on the inner tube end portion 82 adjacent the free end of this tube portion, and thus at a position which is axially spaced from the ball bearing 86. The outer surface of the elastomeric bushing 88 fits tightly against the inner surface of the outer tube end portion 84.

During operation of the suspension system, as the rear wheels rise and fall relatively to the sprung portion of the vehicle, the locus of movement of the axis of wheel rotation, as seen from the side of the vehicle, is determined by the Watts linkage formed by the first and second pairs of pivotal links 28 and 30, 40 and 42, the Watts linkage maintaining the axle assembly at a constant attitude or castor angle. As seen from the front of the vehicle, as the rear wheels rise and fall, the axle assembly moves in an arc whose radius is determined by the length of the Panhard rod, with the geometrical discrepancy between the arc of movement permitted by the Panhard rod and the arc of movement of the left-hand pivotal drive shaft being accommodated resiliently by means of rubber bushings in the suspension. No relative telescopic movement of the two parts 24 and 26 of the De Dion tube 20 is possible, because the ball bearing prevents such telescopic movement. The wheel track thus remains constant as the rear wheels rise and fall, with the variation in the effective length of the pivotal drive shafts being accommodated resiliently by the coupling joints 70.

During body roll, namely when one rear wheel rises and the other falls relatively to the sprung portion of the vehicle, the Watts linkage tends to cause twisting of the De Dion tube. This twisting movement is resiliently resisted by the annular elastomeric bushing 88 between the two parts of the De Dion tube, the amount of torsional resistance provided by this annular bushing being determined by the length of the bushing. If only a very small amount of torsional resistance is required in the rear suspension system of a given vehicle, the annular elastomeric bushing can be made very short, in which case its main function will be to maintain the free end of the inner of the coaxially overlapping portions of the De Dion tube resiliently centred relatively to the outer of the tube portions rather than to provide any substantial resilient resistance to body roll. On the other hand, if a large amount of torsional resistance is required in the De Dion tube, the annular elastomeric bushing can be made longer: in this way an anti-roll effect can be obtained, in addition to the resilient centring of the free end of the inner of the coaxially overlapping portions of the De Dion tube.

The motor vehicle suspension system which

has just been described thus gives a controlled amount of torsional resistance to roll movement, and maintains the rear wheel track constant during rise and fall of these wheels.

WHAT WE CLAIM IS:—

1. A suspension assembly for use in a motor vehicle suspension system, comprising a De Dion tube made up of two parts having overlapping end portions which extend coaxially one into the other, an annular anti-friction bearing which is fitted between the overlapping end portions of the tube and is constructed and arranged to resist relative telescopic movement of the two parts of the tube, and an annular resilient bushing which is fitted between the overlapping end portions of the tube at a position axially spaced from the anti-friction bearing and is constructed and arranged to resiliently resist relative torsional movement of the two parts of the tube.

2. A suspension assembly according to claim 1, wherein the anti-friction bearing comprises a ball bearing which has an inner race fitted on the inner of the coaxially overlapping end portions of the tube, and has an outer race in engagement with the inner surface of the outer of the coaxially overlapping end portions of the tube.

3. A suspension assembly according to claim 1 or 2, wherein the annular elastomeric bushing is fitted on the inner of the coaxially overlapping end portions of the tube, and fits tightly against the inner surface of the outer of the coaxially overlapping end portions of the tube.

4. A suspension assembly according to any one of claims 1 to 3, wherein the annular resilient bushing of the suspension assembly is made of either natural rubber, a modified natural rubber, or a synthetic elastomer.

5. A suspension assembly according to any one of claims 1 to 4, wherein the anti-friction bearing is disposed in the region of the free end of the outer of the coaxially overlapping end portions of the tube, whereas the annular resilient bushing is disposed in the region of the free end of the inner of the coaxially overlapping end portions of the tube.

6. A suspension assembly according to any one of claims 1 to 5, wherein an annular sealing boot of elastomeric material interconnects the two parts of the De Dion tube, for preventing the entry of dirt and moisture.

7. A suspension assembly for use in a motor vehicle suspension system, substantially as hereinbefore particularly described and as shown in the accompanying drawings.

8. A suspension system for a motor vehicle, comprising: an axle assembly including a transverse pair of wheel carriers interconnected by a suspension assembly according to any one of claims 1 to 6 disposed with the De Dion tube extending transversely of the vehicle; a differential gear assembly which forms part of a sprung portion of a vehicle and includes opposed output shafts that are pivotally connected by way of respective pivotal drive shafts for driving respective wheels rotatably mounted on respective wheel carriers; a first pair of pivotal links arranged with front end portions thereof pivotally connected to a frame or body portion of the vehicle, and with rear end portions thereof pivotally connected to the axle assembly at positions lower than the axis of rotation of the wheels; and a second pair of pivotal links arranged with rear end portions thereof pivotally connected to the frame or body portion of the vehicle, and with front end portions thereof pivotally connected to the axle assembly at positions higher than the axis of rotation of the wheels.

9. A suspension system according to claim 8, including a pair of main suspension springs acting on respective ones of the first pair of pivotal links.

10. A suspension system according to claim 9, wherein the main suspension springs comprise helical compression springs.

11. A suspension system according to any one of claims 8 to 10, wherein a resilient pivotal coupling joint is disposed at one end of each of the pivotal drive shafts.

12. A suspension system according to claim 11, wherein each resilient pivotal coupling joint is disposed at the inboard end of the respective drive shaft, and comprises a ring of elastomeric material connected by a first set of bolts to a first spider, and connected by a second set of bolts to a second spider, the two sets of bolts being in staggered relationship.

13. A suspension system according to any one of claims 8 to 12, including a Panhard rod arranged for transverse location of the De Dion tube.

14. A suspension system according to claim 13, wherein the ends of the Panhard rod are connected respectively to the left-hand end portion of the De Dion tube (as seen when looking in the forward direction of the vehicle) and to a part of the frame or body portion at the right-hand side of the vehicle.

15. A suspension system according to any one of claims 8 to 14, wherein the differential gear assembly forms part of a sub-frame that is resiliently connected to the sprung portion of the vehicle.

16. A suspension system according to claim 15, wherein the sub-frame is substantially H-shaped as seen in plan, with at least one pair of the arms of the H extending obliquely.

17. A suspension system for a motor vehicle, substantially as hereinbefore particularly described and as shown in the accompanying drawings.

18. A front-engined motor vehicle having a suspension system according to any one of claims 8 to 16 for a pair of driven rear wheels of the vehicle.

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Chartered Patent Agent.

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1131479 COMPLETE SPECIFICATION

3 SHEETS *This drawing is a reproduction of the Original on a reduced scale*

Sheet 1

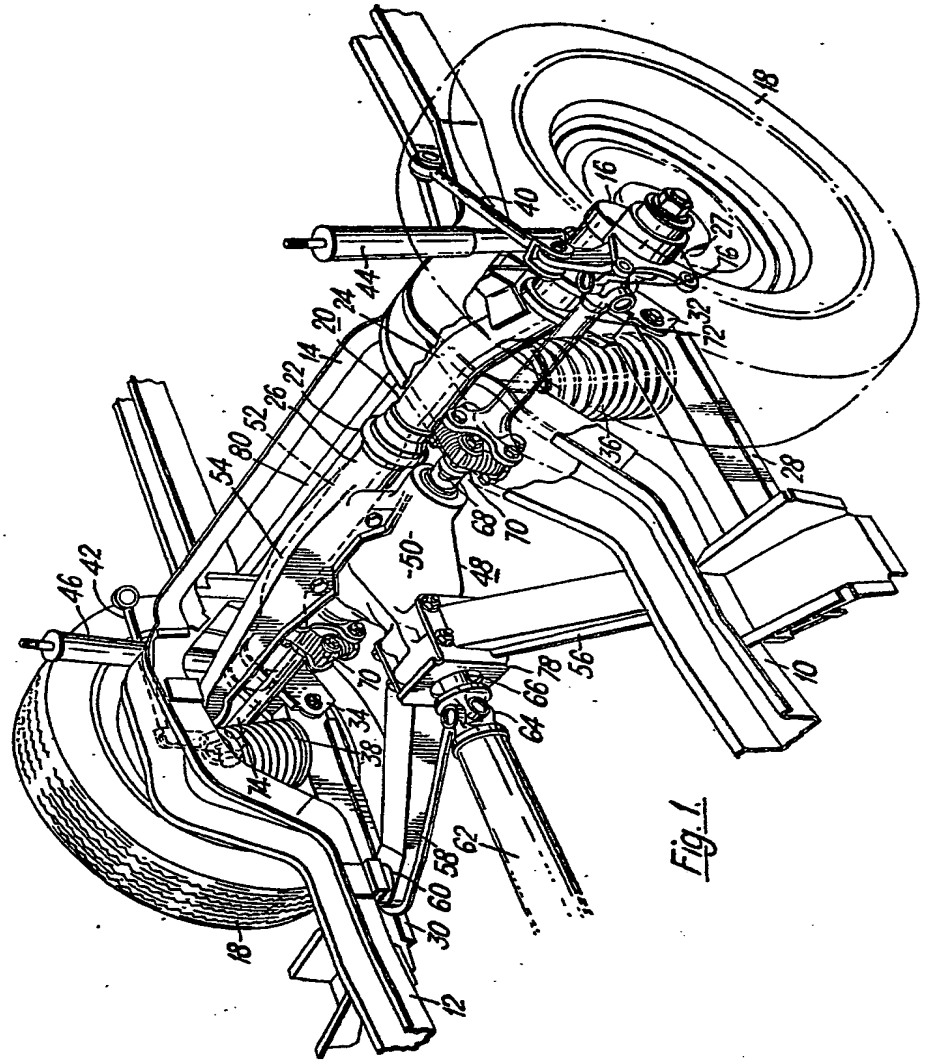

Fig. 1.

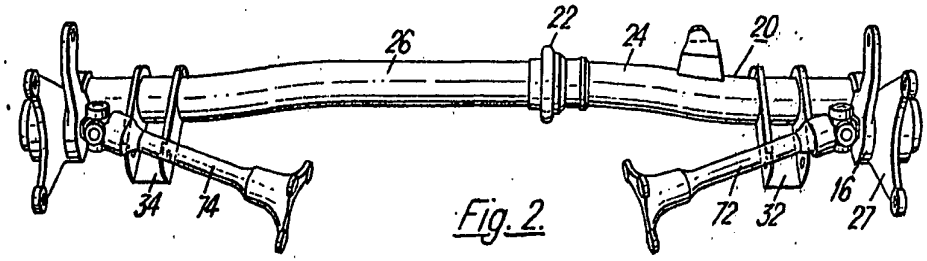

Fig. 2.

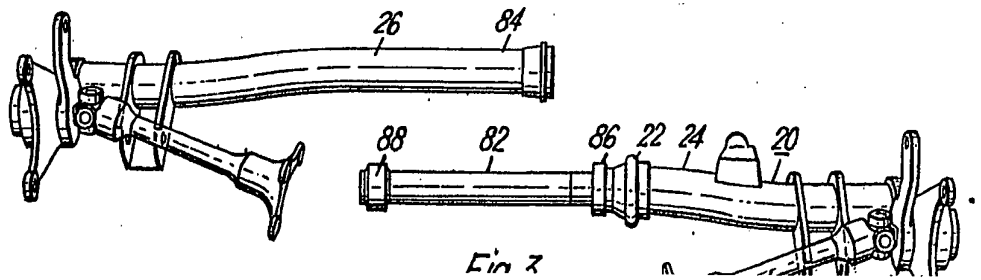

Fig. 3

1131479 COMPLETE SPECIFICATION

3 SHEETS *This drawing is a reproduction of the Original on a reduced scale*

Sheets 2 & 3

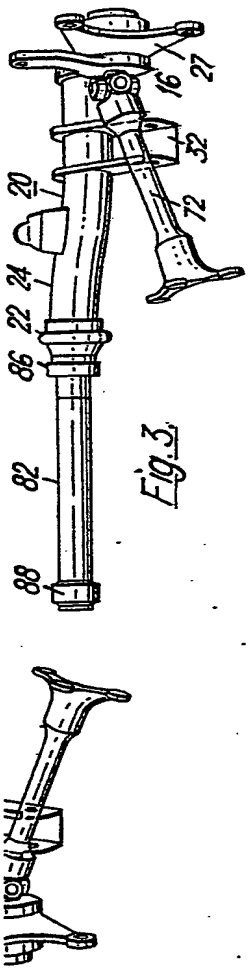

Fig. 3.

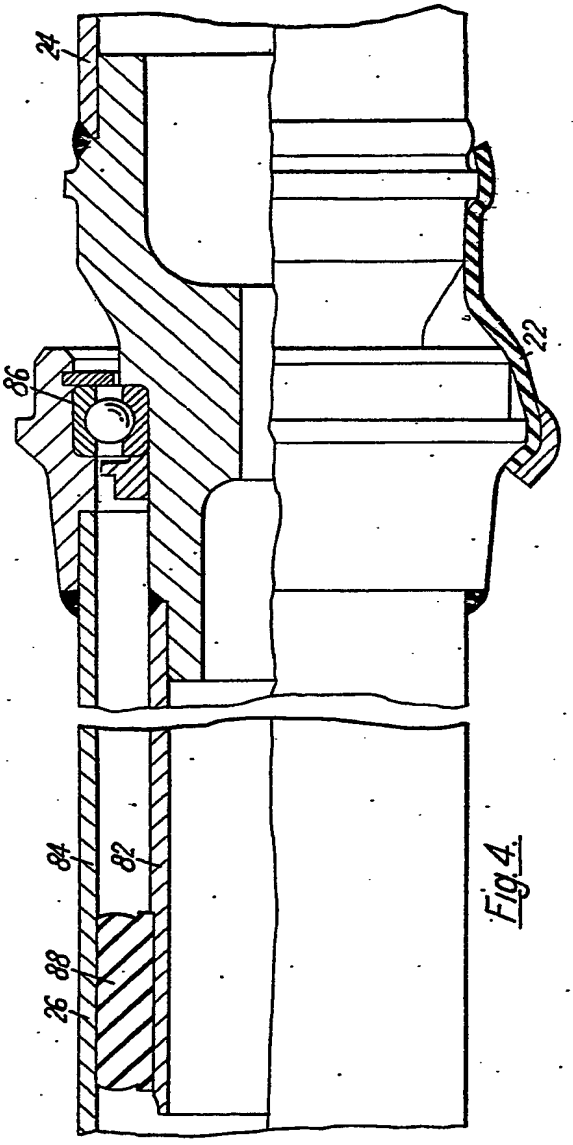

Fig. 4.

1131479 COMPLETE SPECIFICATION

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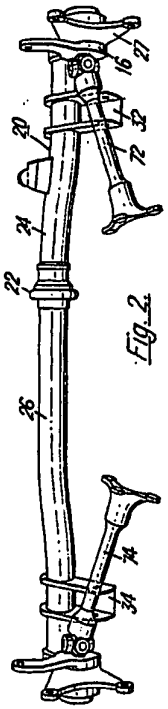

Fig. 2.

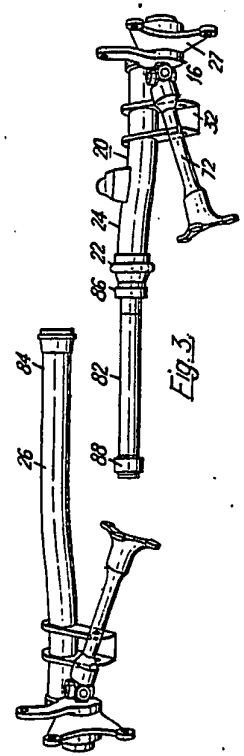

Fig. 3.

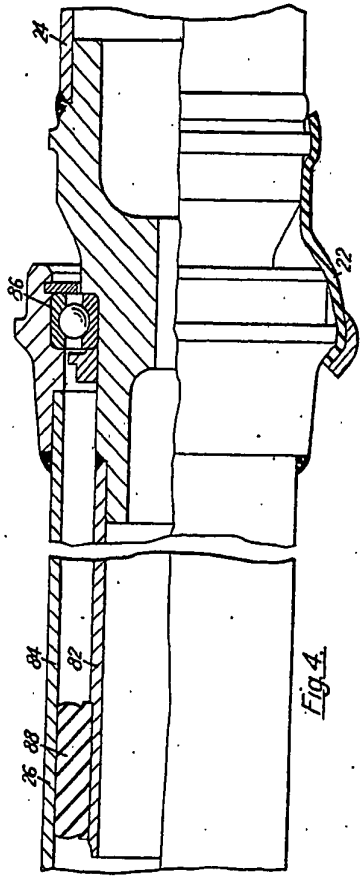

Fig. 4.